INTERNATIONAL COOPERATION FOR WATER RESOURCES PRESERVATION: THE CASE STUDY OF QUETZALTENANGO AREA, SW GUATEMALA

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Project background: water issues

Guatemala is characterized by recent urban and industrial development with population growth rate nearly 2% and **accessibility to water resources** represents one of the main social and political issues (**Fig. 1**).

The **upper basin of Samalá River** (**Fig. 2**), located in Quetzaltenango Department (SW Guatemala), is one of the regions with the highest population and productive activities density. Half of the population living **in rural areas** has **no access to potable water** and human pressure is considerable in reason of 500 000 inhabitants living in 850 km^2. **Groundwater** is the **main water resource** for both drinking, domestic, agricultural and industrial purposes (**Fig. 3 A, B**). Nevertheless, its **preservation** is **endangered** by various issues: excessive exploitation of groundwater, land use changing, decrease of forestry cover, lack of long-term plans for natural resources exploitation, pollution by wastewater inlets and inappropriate waste treatment. Local development program reports expose that the land overuse: 61% of basin surface is occupied by husbandry and agricultural practice (**Fig. 3 C**) and more than 2% by urban centers, industrial parks and road infrastructures.

That being so, relationships between Turin and Quetzaltenango authorities, since 1997, pointed to deepen the **awareness about groundwater resources and their protection** in Quetzaltenango area and its surrounding territory, identified as the upper basin of Samalá River.

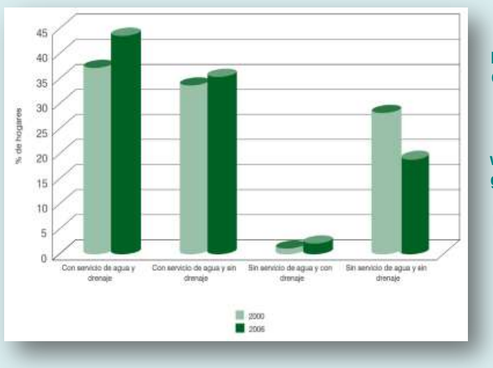

Fig 1. – % of Guatemalan dwellings reached by potable water/drainage networks (by IARNA/URL 2009)

Fig. 3 – Water resources in upper basin of Samalá River. (A) Underground trenches in pyroclastic deposits, used for groundwater interception and extraction (Siguilá Valley). (B) Municipal well near Quetzaltenango city. (C) Typical rural landscape with intense agricultural and quarry activities (S.J. Ostuncalco)

Fig. 2 – The upper basin of Samalá River in a wide shot from S to N. The main towns and villages are shown

The territory: hazards and resources

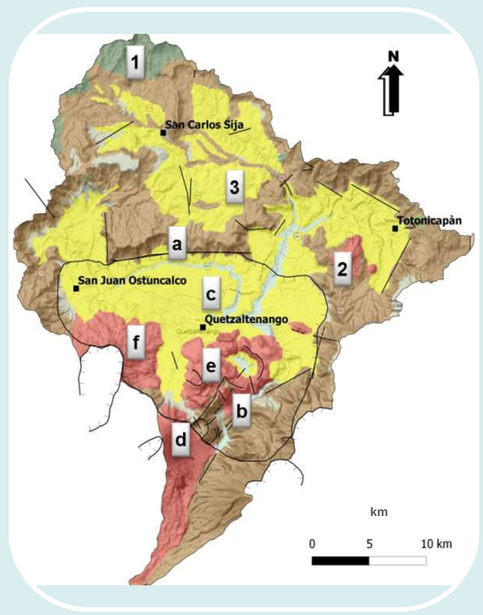

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Fig. 4 - Geological schematic map with the main lithological, tectonic and volcanic features: (a) Olintepeque Fault, (b) Zunil Fault System, (c) Xela caldera, (d) S. María-Santiaguito volcano, (e) Cerro Quemado volcano, (f) Siete Orejas volcano. (1) Cretaceous Intrusive rocks, (2) Tertiary (brown) and Quaternary (red) volcanites, (3) Pyroclastic deposits

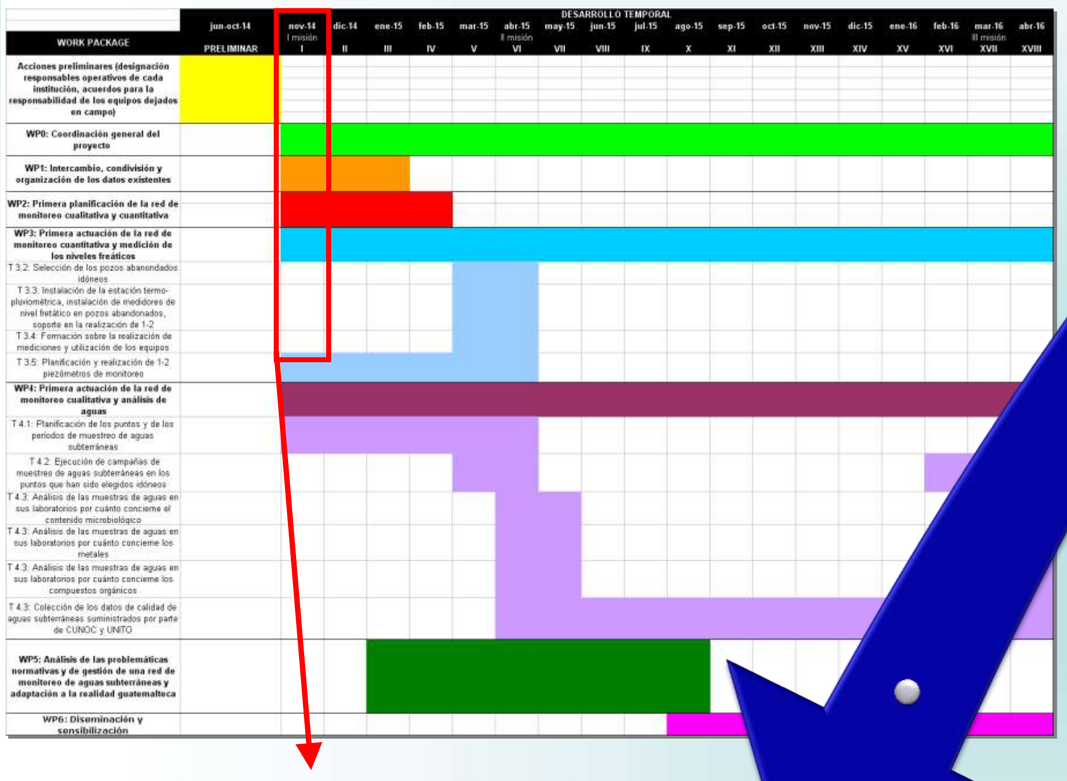
Guatemala is in the middle of three plates. From their interaction, various tectonic and volcanic features were originated: faults, stratovolcanoes, dome complexes and calderas characterize and endanger the upper Samalá River basin (**Fig. 4 – d,e**). The **intense volcanic activity** occurred since 20 million years ago produced great volumes of volcanic rocks and **pyroclastic deposits** (**Fig. 4 - 3**). These deposits represent one of **the main groundwater reservoir** because of their features: high permeability degree due to their coarse-sized grain fabric and a large volumetric extent given by ubiquitous presence and relevant thickness (up to 250 m).

Only in Quetzaltenango area **70 private wells** have been drilled for industrial, agricultural and domestic purposes (CES 2003). Generally speaking, public water supply service is managed by municipal authorities in urban centers and by committees in rural communities. The major water service company in Samalá River basin is **EMAX**, that manages the water service in Quetzaltenango municipality through the use of **25 wells and 15 springs**.

Relationships between Turin and Quetzaltenango: past, present and future

The project, following the example of Piedmont Region, aims to define two types of monitoring networks:
a) **Quantitative monitoring network**: control of the variations of groundwater resources during time considering water balance and withdrawals
b) **Qualitative monitoring network** for the assessment of natural chemical features of groundwater and possible pollution phenomena.

Both are designed with a **modular logic**, that means both providing a limited number of monitoring points and promoting the coordination among local authorities. The total duration of **18 months**. Its chronological development is divided into **6 work packages**, each one assigned to one or more institutions.



We started in **November 2014** with preliminary data collection, on-field identification of wells/springs, first assessment of their suitability to become monitoring points and water sampling campaign for chemical analysis:

1997: *Twinning agreement* between Turin and Quetzaltenango Municipalities, aimed at enforcing peace and democracy

Fig 5 – The twinning agreement documents between Quetzaltenango (left) and Turin (right)

1998-2000: *Implementation of a chemical-biological laboratory for Quetzaltenango aqueduct*

Project lead by public authorities of water service SMAT-Città di Torino (Turin) and EMAX (Quetzaltenango)

2008-2013: *Institutional reinforcement Turin-Quetzaltenango*
Founded by ATO3, lead by SMAT-UNITO-Città di Torino (Turin) and EMAX-CUNOC (Quetzaltenango)
+
2 graduate thesis and 1 outgoing scholarship in UNITO dedicated to the *assessment of groundwater chemistry and quality*

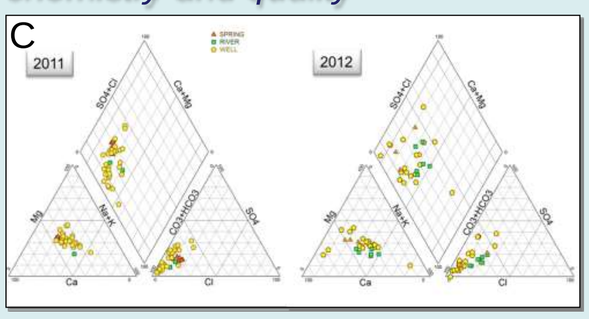


Fig. 6 – Images from 2008-2013 lapse. (A) The EMAX lab in Quetzaltenango during UNITO team's visit. (B) Water sampling from a well in Quetzaltenango during the first campaign in 2012. (C) Piper diagrams showing the main chemical species of water samples collected during 2011 and 2012 surveys

2014-2016: *Design and first implementation of a monitoring network for groundwater protection in Quetzaltenango area (Guatemala)* involving UNITO-Città di Torino (Turin) and EMAX-CUNOC-Mancomunidad (Quetzaltenango)

Fig. 7 – (A) Water level measurements in a well in Quetzaltenango. (B) Water sampling from municipal collection tanks and data-gathering

Subsequently, for the quantitative network some points suitable for **monitoring of groundwater levels** will be selected, both existing and newly installed. Some of them will be instrumented for the measurement of water levels. A **weather station** will also be installed in for the measurement of parameters useful for the calculation of the hydrologic balance.

Defined a core group of quality monitoring points, we will proceed with the execution of **groundwater sampling campaigns**. Analyses will be distributed among the various entities involved. Based on the results obtained in the different cycles of analysis, the most critical **types of pollutants** will be identified on which to focus for the future.

2016-future: further enlargement and completion of the monitoring network

MORE PARTICIPATION of local territories and further FUND RAISING will be needed!!

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